PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-031316

(43)Date of publication of application : 28.01.2000

(51)Int.Cl. H01L 23/12

(21)Application number : 10-194576

(22)Date of filing : 09.07.1998

(71)Applicant : NEC CORP

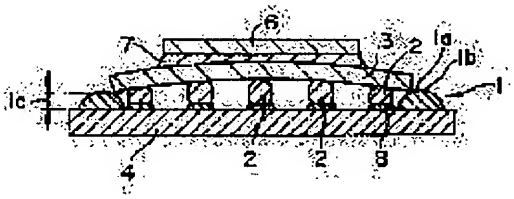
(72)Inventor : ISHIBASHI MASAHIRO

(54) MOUNTING STRUCTURE OF SURFACE MOUNT SEMICONDUCTOR DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To stably mount a semiconductor device on a mother board through solder balls at a low cost regardless of the warping state of the device by providing a surface mount jig which supports the semiconductor device separately from a mother board at the time of reflowing the solder balls between the mother board and semiconductor device.

SOLUTION: A surface mount jig 1 which is used for supporting an intermediate board 3 is provided on a mother board 4 having board pads 8 and solder balls 2 are formed on the rear surface of the intermediate board 3 to which a semiconductor chip 6 is bonded with a mount material 7. At the time of bonding the intermediate board 3 to the mother board 4, solder balls are sufficiently melted by prolonging the reflow heating time or raising the temperature. At the time of bonding the board 3 to the board 4, in addition, the occurrence of such a state that the solder balls 2 are crushed and protrude from the board pads 8 is avoided by supporting the board 3 by the surface mount jig 1 from four sides. Therefore, the intermediate board 3 can be easily arranged on a prescribed position of the mother board 4 by means of the jig 1.



LEGAL STATUS

[Date of request for examination] 09.07.1998

[Date of sending the examiner's decision of rejection] 22.08.2000

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3168987
[Date of registration]	16.03.2001
[Number of appeal against examiner's decision of rejection]	2000-15075
[Date of requesting appeal against examiner's decision of rejection]	21.09.2000
[Date of extinction of right]	

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Mounting structure of the surface mount mold semiconductor device characterized by preparing the fixture for surface mounts which is the mounting structure of the surface mount mold semiconductor device connected to a mother board by the solder ball with which the inferior surface of tongue of a semiconductor device was equipped, and has the work supported where said semiconductor device is estranged with said mother board at the time of the reflow of said solder ball between said mother boards and said semiconductor devices.
[Claim 2] Said fixture for surface mounts is the mounting structure of the surface mount mold semiconductor device according to claim 1 characterized by the field which consists of two or more fixtures and touches the edge of said the semiconductor device being the spherical surface-like.
[Claim 3] Said fixture for surface mounts is the mounting structure of the surface mount mold semiconductor device according to claim 1 or 2 characterized by having the function to position a semiconductor device on a mother board.
[Claim 4] Mounting structure of a surface mount mold semiconductor device given in claim 1 which the two or more step laminating of said semiconductor device is carried out, and is characterized by said fixture for surface mounts intervening between each semiconductor device thru/or any 1 term of 3.
[Claim 5] Mounting structure of a surface mount mold semiconductor device given in claim 1 characterized by said semiconductor device having the structure of a bare chip mold thru/or any 1 term of 4.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the mounting structure of the surface mount mold semiconductor device which eases curvature and raises connection dependability in semiconductor devices, such as BGA (Ball Grid Array) structure electrically joined to a mother board with the solder ball arranged on the inferior surface of tongue, and flip chip structure, about the mounting structure of a surface mount mold semiconductor device.
[0002]
[Description of the Prior Art] Drawing 16 is the sectional view showing the conventional surface mount mold semiconductor device. In drawing 16 , the semiconductor chip 26 is carried in the middle substrate 23 using the mounting material 27. The semiconductor chip 26 is protected using closure resin 25. The solder ball 22 is formed in the rear face of the middle substrate 23 in the shape of a matrix, and the semiconductor device 21 is constituted. (The middle substrate in which it was not concerned with the existence of closure resin, but the semiconductor chip was carried hereafter is called a semiconductor device)
[0003] The semiconductor chip 26 and the mother board 24 are electrically connected by the substrate pad 28 being formed in the mother board 24, and, carrying out alignment of the solder ball 22 and the substrate pad 28 on the other hand, fusing the solder ball 22 with reflow heating, and joining by solder. Generally, various devices have been made, in case the whole has curved intricately in many cases and this kind of semiconductor device joins the substrate pad 28 on a mother board to the solder ball 22 by the difference in the coefficient of thermal expansion of each ingredient, or contraction of closure resin.
[0004]
[Problem(s) to be Solved by the Invention] However, in the conventional semiconductor device, it was unknown whether a semiconductor device curves in a semiconductor chip side at a concave or it curved in convex, and since dispersion was in the amount of curvatures with a semiconductor device, there was a problem that low cost and stable solder ball mounting could not be performed.
[0005] Drawing 16 is the example of the semiconductor device with which the semiconductor device curved in the semiconductor chip side at the concave, and drawing 17 is the example of the semiconductor device with which the semiconductor device curved in convex at the semiconductor chip side. In case alignment of the solder ball 22 and the substrate pad 28 is carried out and it joins with reflow heating, in the semiconductor device which curved in the semiconductor chip side as shown in drawing 16 at the concave In the semiconductor device 21 with which the solder ball 22 of the periphery section curved in convex at the semiconductor chip side as shown in drawing 17 The solder ball 22 of a center section came floating, the solder ball 22 and a substrate pad 28 could not fully join, but a possibility that the electrical installation dependability of a semiconductor chip 26 and a mother board 24 might become inadequate was in regular reflow time amount.
[0006] Moreover, when reflow time amount was enough lengthened so that all solder balls 22 and substrate pads 28 may fully join, as shown in drawing 18 , some solder balls 22 were crushed, and the problem that it did not ride as a convention was on the substrate pad 28. Moreover, the pointing device for carrying out alignment of the substrate pad 28 prepared in the inferior surface of tongue of the middle substrate of a semiconductor device at the mother board 24 in surface mount mold

semiconductor devices, such as BGA structure joined to a mother board and flip chip structure, with the solder ball arranged in the shape of a matrix and the solder ball 22 arranged in the shape of a matrix at the semiconductor device was needed, and there was a problem of becoming cost quantity compared with the conventional surface mount mold semiconductor device.

[0007] Even if the periphery section of a middle substrate curve by the solder ball of a semiconductor device outside make the height of the solder ball of a middle substrate high , and carry out the top-most vertices of all solder balls on the same flat surface mostly , the approach all solder balls and substrate pads contact almost similarly , and raise the dependability of solder bump junction in the case of soldering by reflow heating be indicate by JP,8-125062,A . However, there are the following troubles in this approach.

[0008] In the first place, it is mentioned that semiconductor devices, such as BGA, do not always curve in the tip side at a concave. When semiconductor devices, such as BGA, curve [second] in the tip side extremely at a concave, the amount of solder of the solder ball of the periphery section will be increased extremely, and there is a possibility that it will be necessary to change to the width of face of the substrate side pad corresponding to the solder ball of the periphery section.

[0009] It is difficult third to predict the amount of curvatures of semiconductor devices, such as BGA, and even if it can adjust the amount of solder for solder ball height control, it is difficult for it to set up the optimal height of the solder ball which will be the requisite. Since the amount of curvatures of a semiconductor device has [fourth] dispersion with a lot, it is thought that it is in practice very difficult to adjust solder ball height by the degree of the amount of solder.

[0010] Generally, the semiconductor device of the type which protects a semiconductor chip by closure resin adopts the way of curving with a complicated middle substrate owing to the difference in the coefficient of thermal expansion of closure resin and a middle substrate, the difference in the coefficient of thermal expansion of a semiconductor chip and a middle substrate, and contraction of closure resin. For example, the part which the part on which the semiconductor chip was mounted does not have curvature and a semiconductor chip to a semiconductor chip side in convex, and closure resin and a middle substrate have pasted up is curving in a semiconductor chip side at a concave etc. For this reason, even if it was going to change the height of a solder ball by the degree of the amount of solder and was going to join by solder equally as shown in JP,8-125062,A, since time amount was taken and it became high cost-ization, changing the amount of solder into other phases according to dispersion in curvature had the trouble of not being practical.

[0011] Generally, since semiconductor devices, such as BGA structure and flip chip structure, cannot inspect all soldered joint parts visually by the metal leadframe projected from two sides of a semiconductor device, or four sides unlike the conventional semiconductor device joined to a mother board, inspection of connection dependability takes great time amount and cost to them. When the diameter of a solder ball becomes smaller and a solder bump's spacing benefits a miniaturization and densification smaller, time amount and cost start further, and it becomes a still more important technical problem to perform solder ball mounting stabilized in low cost. This invention will aim at offering the mounting structure of the surface mount mold semiconductor device which enabled solder ball mounting which is low cost and was stabilized, however the semiconductor device may have curved in view of the above-mentioned point.

[0012]

[Means for Solving the Problem] Mounting structure of the surface mount mold semiconductor device concerning this invention is characterized by preparing the fixture for surface mounts which has the work which supports a semiconductor device in the condition of having estranged with the mother board, at the time of the reflow of a solder ball between a mother board and a semiconductor device. Thus, by lengthening time amount of reflow heating, making high temperature of a soldered joint or reflow heating, and joining it by solder, since the fixture for surface mounts is prepared between the mother board and the semiconductor device, even if a solder ball fully fuses, spacing of a mother board and a semiconductor device is kept constant. Therefore, even if it is adopting the complicated way of curving though the semiconductor device has curved in which to the semiconductor chip and, the effectiveness that low cost and stable solder ball mounting are attained is acquired.

[0013] As for this fixture for surface mounts, it is desirable that the field which exist and touches the edge of a semiconductor device is the spherical surface-like. [two or more] That is, since it is the

structure which supports a semiconductor device with the fixture of the shape of the spherical surface established on the mother board, if a semiconductor device curves and lay length parallel to a mother board becomes short, the supporting point of the semiconductor device by the spherical-surface-like fixture will change. For this reason, even if a semiconductor device curves greatly in convex at the tip side, the height from a mother board to the supporting point of the middle substrate by the spherical-surface-like fixture becomes low, and the height of the solder ball of a center section does not become high beyond a certain fixed value. Therefore, since the height of the solder ball of a center section can be kept constant even if dispersion is in the amount of curvatures of a semiconductor device with a lot, the effectiveness that low cost and stable solder ball mounting are attained is acquired.

[0014] As for the fixture for surface mounts, it is desirable to have the function to position a semiconductor device on a mother board. Thereby, the time amount which the alignment of a solder ball and a substrate pad takes can be shortened sharply. In the mounting structure of the surface mount mold semiconductor device concerning this invention, the two or more step laminating of the semiconductor device is carried out, and even if the fixture for surface mounts intervenes between each semiconductor device, it does not interfere. Furthermore, in the mounting structure of the surface mount mold semiconductor device concerning this invention, even if the semiconductor device has the structure of a bare chip mold, it does not interfere.

[0015]

[Embodiment of the Invention] Hereafter, although a drawing explains this invention to a detail, this invention is not limited only to these examples of an operation gestalt. Drawing 1 is the sectional view showing the 1st example of an operation gestalt of the mounting structure of the surface mount mold semiconductor device of this invention. The perspective view of the fixture for surface mounts with which the ** type Fig. where drawing 2 looked at the 1st example of an operation gestalt of the mounting structure of the surface mount mold semiconductor device of this invention from the tip side, and drawing 3 are used for the mounting structure of the 1st operation gestalt, and drawing 4 are the sectional views showing the example which applied the mounting structure of the surface mount mold semiconductor device of this invention to the semiconductor device which has a middle substrate with powerful curvature.

[0016] As shown in drawing 1 and drawing 2 , the fixture 1 for surface mounts for supporting the middle substrate 3 is formed in the mother board 4 which has a substrate pad 8. On the other hand, the solder ball 2 arranged in the shape of a matrix is formed in the rear face of the middle substrate 3 to which the semiconductor chip 6 was joined by the mounting material 7. When joining a mother board 4 to the middle substrate 3, time amount of reflow heating is lengthened or a mother board 4 is joined to the middle substrate 3 by making temperature high and fully fusing the solder ball 2. In the case of this junction, by supporting four sides of the middle substrate 3 with the fixture 1 for surface mounts, the solder ball 2 is crushed and a defect, such as overflowing a substrate pad 8, can avoid.

[0017] Moreover, as shown in drawing 2 , the middle substrate 3 can be easily arranged to the position of a mother board 4 with the fixture 1 for surface mounts prepared in the mother board 4. For this reason, an expensive positioning device becomes unnecessary and solder ball mounting which is low cost and was stabilized is attained.

[0018] No soldered joint parts can be inspected visually in semiconductor devices, such as BGA structure and flip chip structure. Especially, the solder ball group 2 near the center section of the semiconductor device cannot be viewed directly. For example, in the case of the semiconductor device which curved in convex at the semiconductor chip side, the solder ball group 2 of a center section tends to come floating, and it is tended to produce a faulty connection but, and since the solder ball group 2 cannot be viewed directly, it is hard to discover a defect.

[0019] If the spherical-surface-like fixture 1 for surface mounts is used, a semiconductor device will curve and a direction parallel to a mother board will become short, the supporting point of the middle substrate by the fixture will change, and height 1c by the supporting point will change from a mother board 4. That is, as shown in drawing 4 , when a semiconductor device curves greatly in convex at a semiconductor chip side, height 1c from a mother board 4 to a middle substrate supporting point becomes low compared with drawing 1 , and the height of the solder ball group 2 of a center section becomes almost fixed. Therefore, if the fixture 1 for surface mounts is formed on a mother board 4 like the mounting structure of the semiconductor device of this invention, since it is stabilized and the

semiconductor device of the various amounts of curvatures can be carried, the effectiveness that low cost and stable solder ball mounting can be performed is acquired.

[0020] Drawing 5 is the sectional view showing the 2nd example of an operation gestalt of the mounting structure of the surface mount mold semiconductor device of this invention. The ** type Fig. where drawing 6 looked at the 2nd example of an operation gestalt of the mounting structure of the surface mount mold semiconductor device of this invention from the tip side, and drawing 7 are the perspective views of the fixture for surface mounts used for the 2nd operation gestalt. As shown in drawing 7 , the fixture 1 for surface mounts prepared on the mother board 4 is a cylindrical object which has notching in part, and this notch is middle substrate supporter 1a and 1d of middle substrate guide sections.

[0021] With the gestalt of this 2nd operation, by lengthening time amount of reflow heating, making high temperature of a soldered joint or reflow heating, and joining it by solder, however the semiconductor device may have curved, since middle substrate supporter 1a is prepared in the fixture 1 for surface mounts, even if a solder ball fully fuses, the duty which keeps constant between a mother board 4 and the middle substrates 3 is achieved. Therefore, the effectiveness that low cost and stable solder ball mounting are attained is acquired. Moreover, since 1d of middle substrate guide sections is prepared in the fixture 1 for surface mounts, it is effective in the ability of the time amount which the alignment of the solder ball 2 and a substrate pad 8 takes to be shortened sharply.

[0022] In addition, the technical range of this invention can add various modification in the range which is not limited to the gestalt of the above-mentioned implementation and does not deviate from the meaning of this invention. If the location of the above 1st and the fixture 1 for surface mounts in the gestalt of the 2nd operation is a location which can support the middle substrate 3, it is not cared about anywhere. Furthermore, if there is a function supporting the middle substrate 3, neither the configuration of the fixture 1 for surface mounts nor a configuration nor the quality of the material will be asked. Moreover, the semiconductor device used for the gestalt of the above 1st and the 2nd implementation does not interfere, even if the solder ball 2 prepared in the inferior surface of tongue of the middle substrate 3 of a semiconductor device is not necessarily arranged in the shape of a matrix like drawing 8 and drawing 9 .

[0023] Furthermore, the semiconductor device used for the gestalt of the above 1st and the 2nd implementation may not be a package like a bare chip. Moreover, the partner joined with the solder ball 2 may not be the circuit board like a mother board 4. For example, like drawing 10 , also when carrying out solder ball junction, it is contained in other semiconductor devices. Even if it is which [above] case, the same effectiveness that low cost and stable solder ball mounting are possible is acquired.

[0024]

[Example] Hereafter, although an example explains this invention concretely, this invention is not limited only to these examples.

(Example 1) This example is an example constituted from a fixture of the shape of a rectangular parallelepiped which beveled the fixture 1 for surface mounts prepared on the mother board 4, as shown in drawing 11 thru/or drawing 13 . The semiconductor device shown in drawing 11 consists of a mother board 4 which prepared the semiconductor device and the fixture 1 for surface mounts of 40mm** which carried the semiconductor chip 6. As for the semiconductor device, the semiconductor chip 6 of 28mm** is mounted on the middle substrate 3 with the silver paste 7. The solder ball 2 with a diameter of 300 micrometers is formed in the rear face of the middle substrate 3 in the shape of a matrix, and the solder ball 2 consists of a solder ball group of the periphery section, and a solder ball group of a center section. In addition, the semiconductor device of this example had curved in convex at the semiconductor chip 6 side. Moreover, the beveled rectangular parallelepiped-like fixture 1 as shown in drawing 13 is formed in the mother board 4 in which the substrate pad 8 was formed.

[0025] First, as shown in drawing 12 , a semiconductor device is put on the mother board 4 in which the beveled rectangular parallelepiped-like fixture 1 was formed. Since the middle substrate 3 of a semiconductor device was guided to middle [the middle substrate guide section-cum-] substrate supporter 1a of a fixture 1 at this time, the time amount which the alignment of the solder ball 2 and the substrate pad 8 formed in the mother board 4 takes has been shortened to about 1/5. In addition, although the solder ball 2 of the same magnitude as the middle substrate 3 of a semiconductor device is formed in the shape of a matrix, in order that the middle substrate 3 may support in a fixture 1, in this phase, no solder ball 2 touches the mother board 4.

[0026] Here, brass is used for the fixture 1 for surface mounts prepared on the mother board 4 as an ingredient which is easy to carry out cutting. As shown in drawing 13 , angle-of-inclination 1e of the supporter of middle substrate supporter 1a of the fixture 1 for surface mounts is beveled so that it may become 60 degrees. By a semiconductor device's curving and becoming short 10 micrometers in parallel at a mother board, a semiconductor device is the include angle whose 17 micrometers are depressed on the whole, and asked the mother board 4 side for this angle of inclination from the curvature of the curvature of ten semiconductor devices. Even if it actually puts the semiconductor device which has dispersion in curvature, it is checked that the distance of the solder ball group of a center section and a mother board 4 becomes almost equal.

[0027] Then, by increasing the time amount of reflow heating 1.5 times over the past, melting of the solder ball 2 was fully carried out, and the semiconductor device was joined by solder to the mother board 4. At this time, being joined by solder to the substrate pad 8 on a mother board 4 as a convention was checked by ultrasonic test equipment. Moreover, also in the electric reliability trial, it was checked that it is in a good soldered joint condition.

[0028] (Example 2) This example is an example established on the mother board 4 so that the fixture 1 for surface mounts might support the four corners of a semiconductor device, as shown in drawing 14 and drawing 15 . The semiconductor device shown in drawing 14 consists of a mother board 4 which prepared the semiconductor device and the fixture 1 for surface mounts of 28mm** which carried the semiconductor chip 6. As for the semiconductor device, the semiconductor chip 6 of 18mm** is mounted on the middle substrate 3 with the aluminum paste 7. The solder ball 2 with a diameter of 100 micrometers is formed in the rear face of the middle substrate 3 in the shape of a matrix, and the solder ball 2 consists of a solder ball group of the periphery section, and a solder ball group of a center section. In addition, the semiconductor device of this example had curved in convex slightly at the semiconductor chip 6 side. Moreover, the fixture 1 for surface mounts of the shape of a cylinder shown in drawing 7 is formed in the location of the four corners of a semiconductor device at the mother board 4 in which the substrate pad 8 was formed. The maximum of the amount of curvatures of a semiconductor device, i.e., the difference of elevation of a solder ball, is about 10 micrometers, and was beforehand measured with the curvature meter.

[0029] First, as shown in drawing 14 , a semiconductor device is laid on the mother board 4 in which the cylindrical shape-like fixture 1 was formed. Although the solder ball group of the periphery section touched the mother board 4 at this time, since the middle substrate 3 of a semiconductor device was guided to 1d of middle substrate guide sections of a fixture 1, the time amount which the alignment of the solder ball 2 and the substrate pad 8 formed in the mother board 4 takes has been shortened sharply. In addition, height 1c of a middle substrate supporting point could be 80 micrometers so that the height after the soldered joint of the solder ball group of the periphery section might be set to about 80 micrometers.

[0030] Then, by making laying temperature of reflow heating into 10-degree-C height, melting of the solder ball 2 was fully carried out, and the semiconductor device was joined by solder to the mother board 4. After the four corners of the middle substrate 3 checked by viewing that it was in contact with middle substrate supporter 1a, as a result of performing an electric reliability trial, it was checked that it is in a good soldered joint condition. Although the semiconductor device had curved in convex slightly in this example at the semiconductor chip 6 side, especially the sense of the curvature of a semiconductor device is not a problem. In addition, it is clear that this invention is not limited to each above-mentioned example, but each example may be suitably changed within the limits of the technical thought of this invention.

[0031]

[Effect of the Invention] By using the mounting structure of the surface mount mold semiconductor device of this invention, it cannot be concerned with the amount of curvatures of a semiconductor device, and the sense of curvature, but the height of the solder ball of a center section can be kept constant, and solder ball mounting with high electrical installation dependability stabilized in low cost can be realized as explained to the detail above.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the 1st example of an operation gestalt of the mounting structure of the surface mount mold semiconductor device of this invention.
[Drawing 2] It is the ** type Fig. which looked at the 1st example of an operation gestalt of the mounting structure of the surface mount mold semiconductor device of this invention from the tip side.
[Drawing 3] It is the perspective view of the fixture for surface mounts used for the 1st operation gestalt.

[Drawing 4] It is the sectional view showing the example which applied the mounting structure of the surface mount mold semiconductor device of this invention to the semiconductor device which has a middle substrate with powerful curvature.
[Drawing 5] It is the sectional view showing the 2nd example of an operation gestalt of the mounting structure of the surface mount mold semiconductor device of this invention.
[Drawing 6] It is the ** type Fig. which looked at the 2nd example of an operation gestalt of the mounting structure of the surface mount mold semiconductor device of this invention from the tip side.
[Drawing 7] It is the perspective view of the fixture for surface mounts used for the 2nd operation gestalt.
[Drawing 8] It is a mimetic diagram for explaining the 2nd example of an operation gestalt.
[Drawing 9] It is a mimetic diagram for explaining the 2nd example of an operation gestalt.
[Drawing 10] It is a mimetic diagram for explaining the 2nd example of an operation gestalt.
[Drawing 11] It is the sectional view showing the gestalt of an example 1.
[Drawing 12] It is the ** type Fig. showing the gestalt of an example 1.
[Drawing 13] It is the perspective view showing the gestalt of an example 1.
[Drawing 14] It is the sectional view showing the gestalt of an example 2.
[Drawing 15] It is the ** type Fig. showing the gestalt of an example 2.
[Drawing 16] It is the sectional view showing the structure of the conventional semiconductor device.
[Drawing 17] It is the sectional view showing the structure of the conventional semiconductor device.
[Drawing 18] It is a ** type Fig. for explaining the conventional semiconductor device.
[Description of Notations]
1 Fixture for Surface Mounts
1a Middle substrate supporter
1b Top-most vertices of a fixture
1c Height of a middle substrate supporting point
1d Middle substrate guide section
1e The angle of inclination of a supporter
2 Solder Ball
3 Middle Substrate
4 Mother Board
5 Closure Resin
6 Semiconductor Chip
7 Mounting Material
8 Substrate Pad